PHƯƠNG PHÁP CHẾ TẠO VẬT LIỆU 1

CHƯƠNG I
GIỚI THIỆU CHUNG

1. Định nghĩa

- Monomer = Mono + mer
  one unit, part, segment
- Polymer = Poly + mer
  many
- Oigomer = oligos + mer
  few

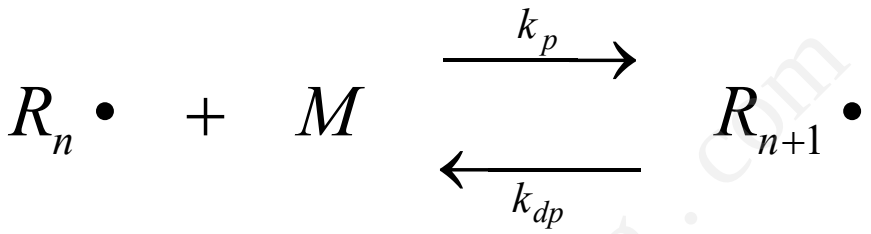
Sự thay đổi về lượng

- Cấu trúc phân tử (cách kết hợp)
- Hình dạng và kích thước
- Sự sắp xếp (lập thể)
- Trọng lượng phân tử
- Độ đa phân tán

Sự thay đổi về chất

- Nhiệt độ chuyển thủy tinh hóa (Tg)
- Độ kết tinh
- Tính chất cơ lý
- Tỷ trọng
- Độ nhớt
- Độ trương
- Nhiệt độ trần (T_C)

Ceiling Temperature (T_C)

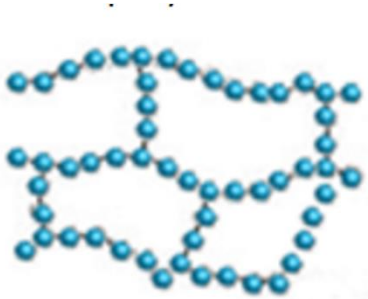


Monomer	Ceiling Temperature (°C)	Structure
1,3-butadiene	585	CH_2=CHCH=CH_2
ethylene	610	CH_2=CH_2
isobutylene	175	CH_2=CMe_2
isoprene	466	CH_2=C(Me)CH=CH_2
methyl methacrylate	198	CH_2=C(Me)CO_2Me
α-methylstyrene	66	PhC(Me)=CH_2
styrene	395	PhCH=CH_2
tetrafluoroethylene	1100	CF_2=CF_2

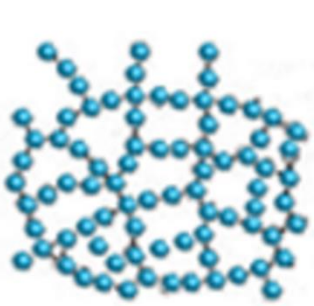
2. Phân loại

- 1. Hữu cơ và vô cơ, vật liệu lai
- 2. Hình thái
- 3. Tự nhiên và biến tính, tổng hợp
- 4. Ứng xử nhiệt

Thermoplastic

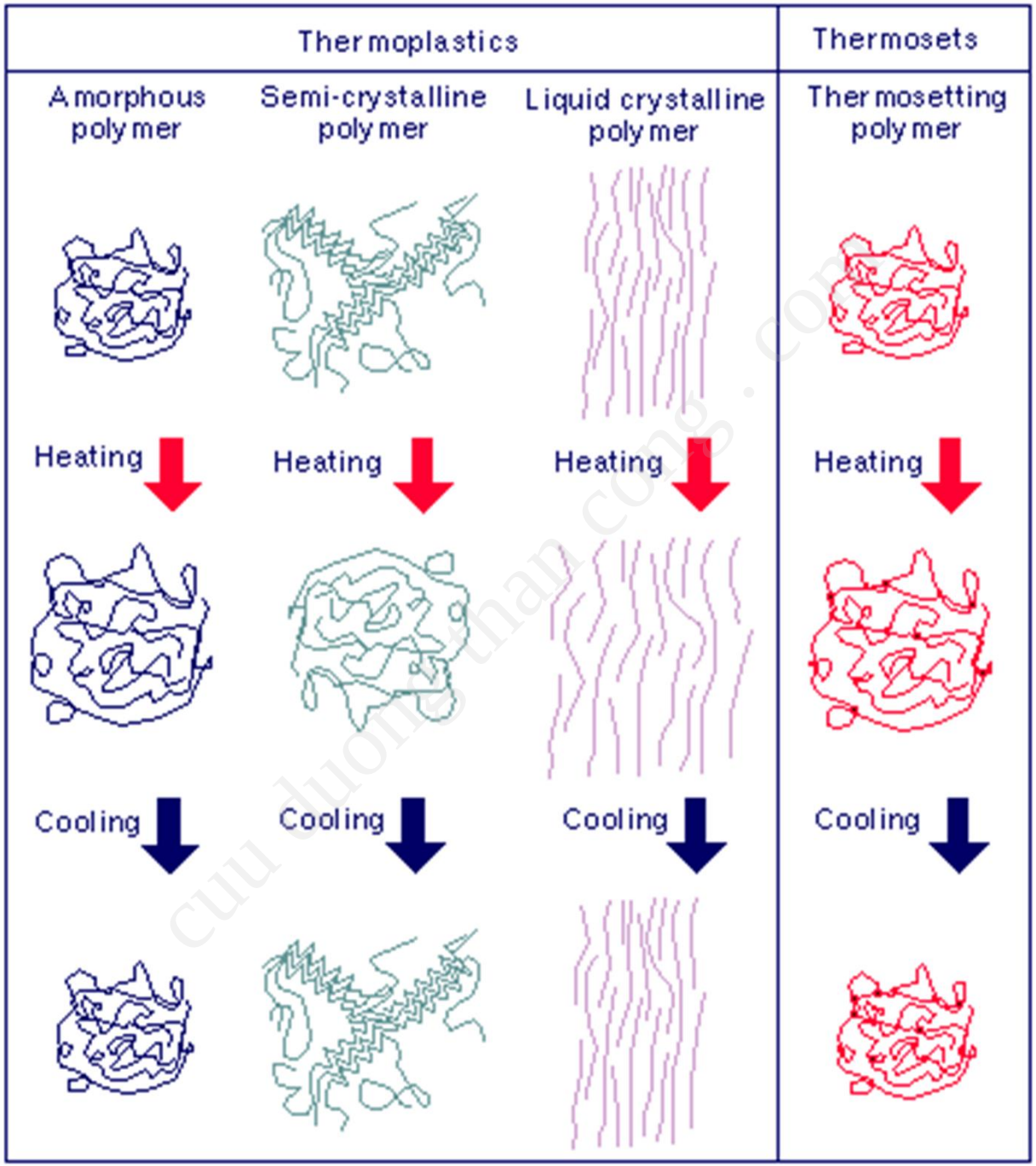


Elastomer



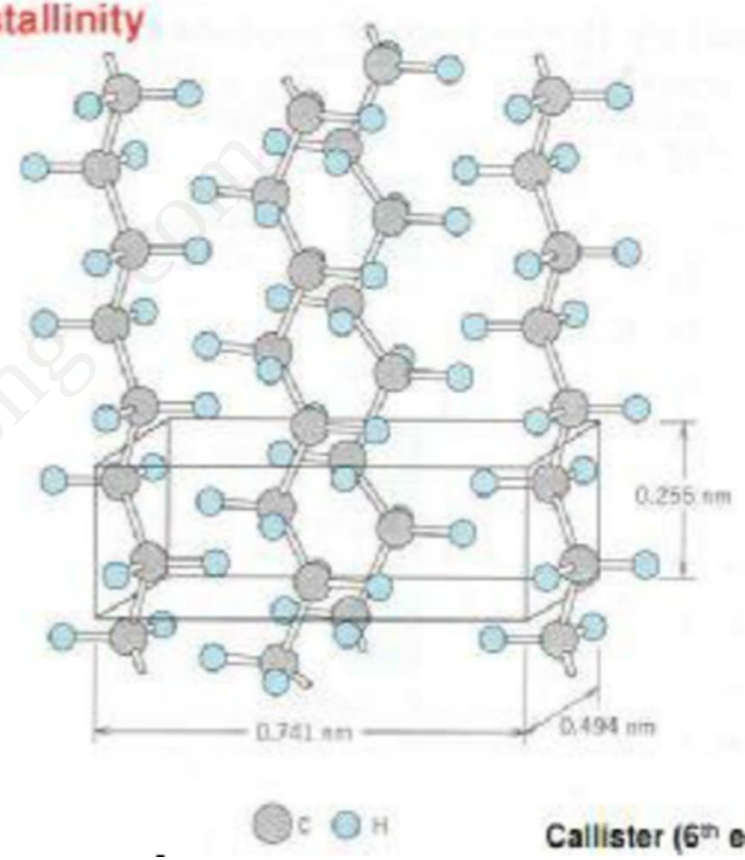
Thermoset

Hình thái



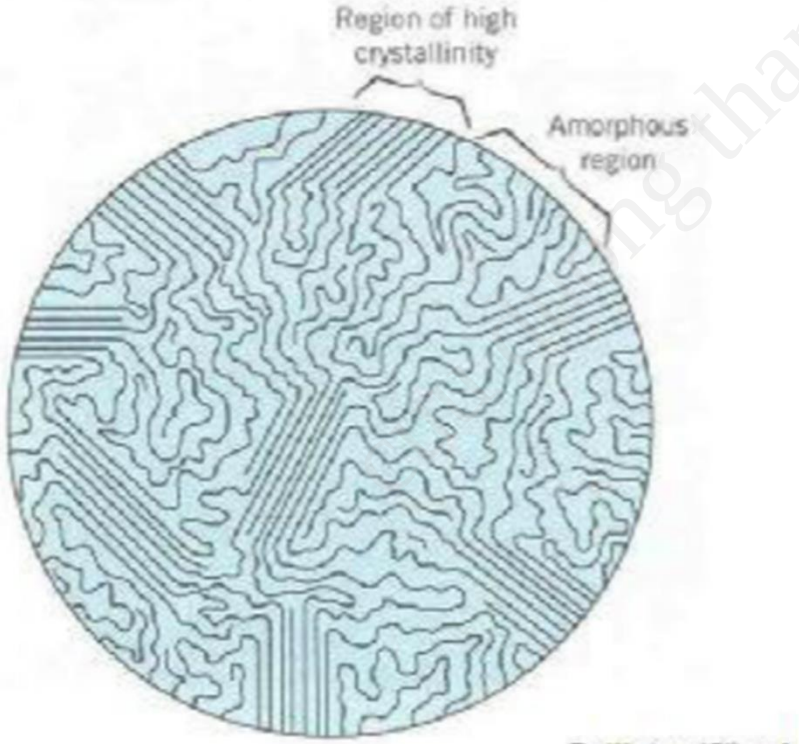
http://www.dc.engr.scu.edu/cmdoc/dg_doc/develop/material/classify/a1000001.htm

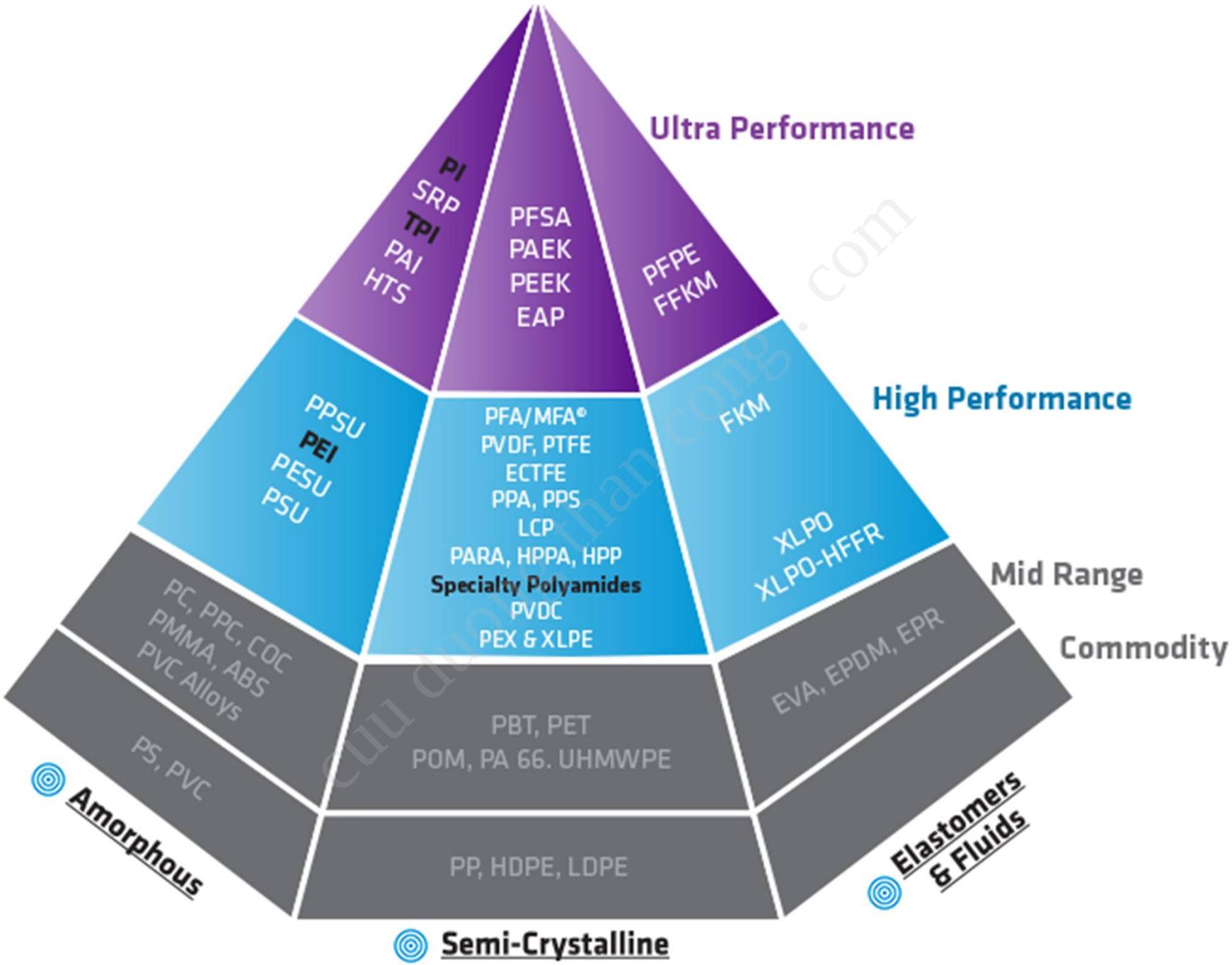
Polymer crystallinity



Callister (6th ed.)

In practice, polymers are semi-crystalline





https://www.healthcarepolymers.com/common/polymeradvantage

POLYMER

- Nhựa
- Sợi
- Liquid resin

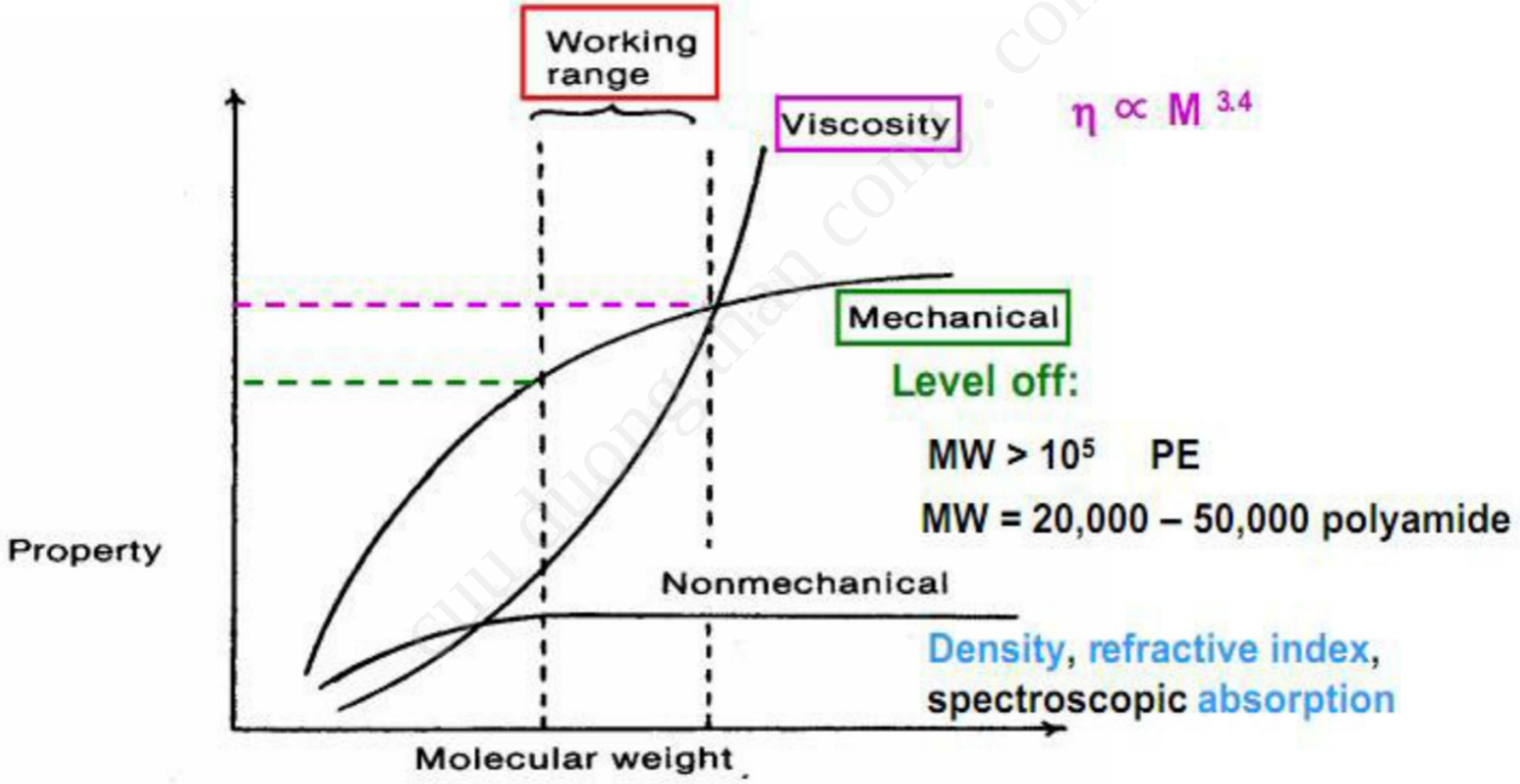
Molecular characteristics

- Chemistry
- Size
- Shape
- Structure

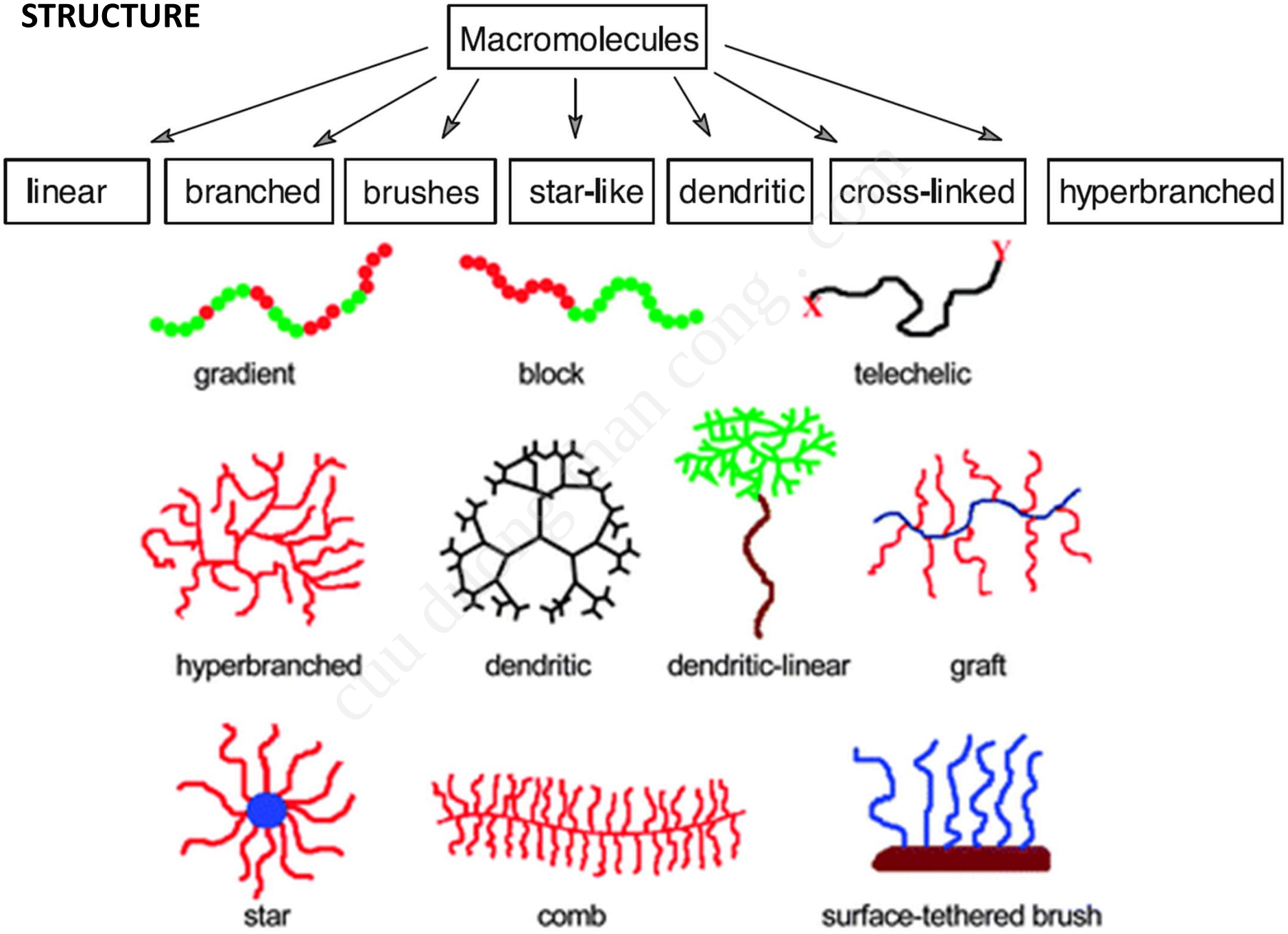
Bonding

- Monomer liên kết cộng hóa trị với nhau $\Rightarrow$ polyme
- Liên kết thứ cấp giữa các polymer:
  - Van der Waals
  - Hydrogen bond
  - Ionic bond

Fig 4.6. Dependence of properties on M.W.



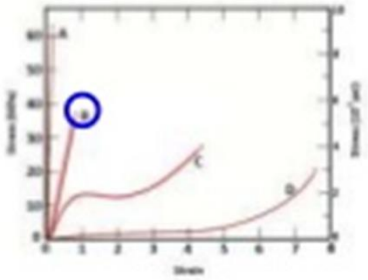
STRUCTURE



Morphology and Thermal & Mechanical Properties

Thermoplastic Polymers

Amorphous Polymer



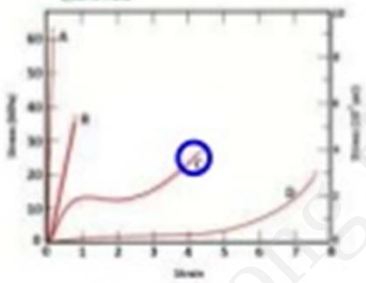
PS Glass

Tg = 100C

T25 < Tg

Glassy

Semicrystalline Polymer



PE Trash Bag

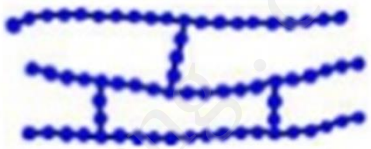
Tg = -90C; Tm = 130C

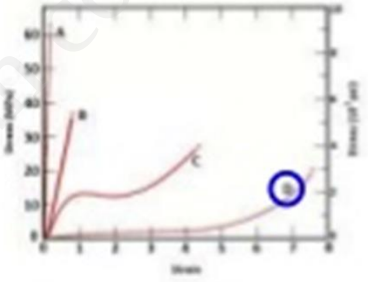
Tg < T25 < Tm

Flexible

Heat Set Polymers

Lightly X-linked Elastomer





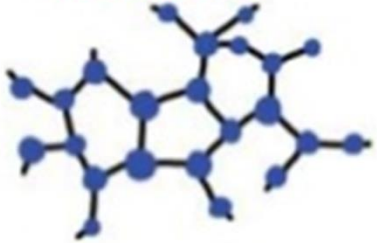
Rubber Shoe Sole

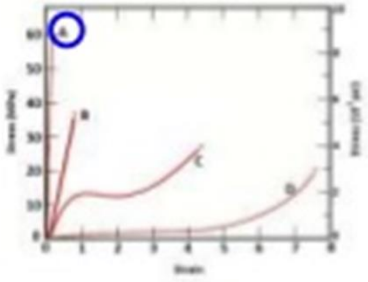
Tg = -103C

Tg < T25

Elastic

Heavily X-linked Thermoset





Bakelite Billiard Balls

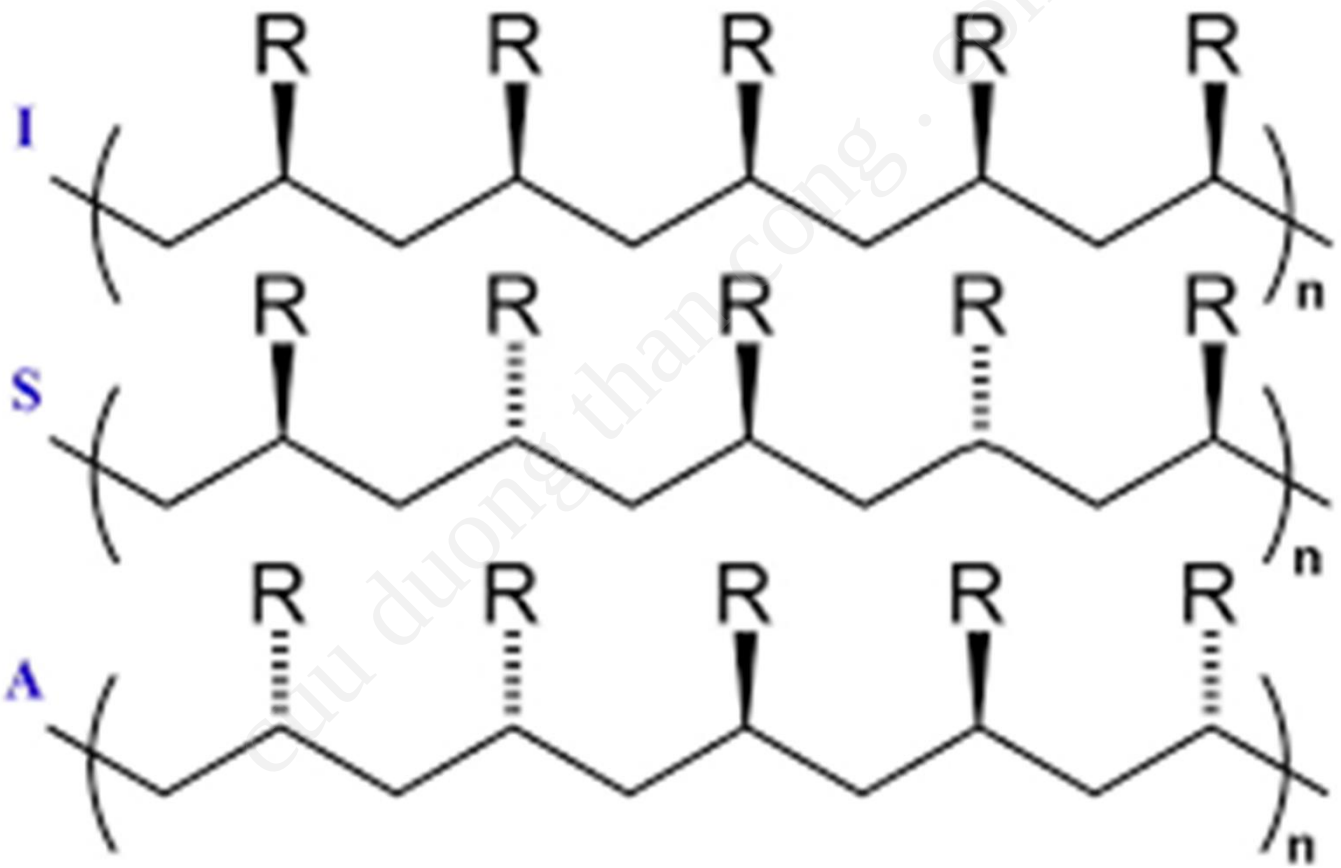
Tg = 163C

T25 < Tg

Rigid

Tg = Glass Transition Temperature, below which a polymer is rigid and brittle

Đồng phân lập thể



Phương pháp tổng hợp polyme

#

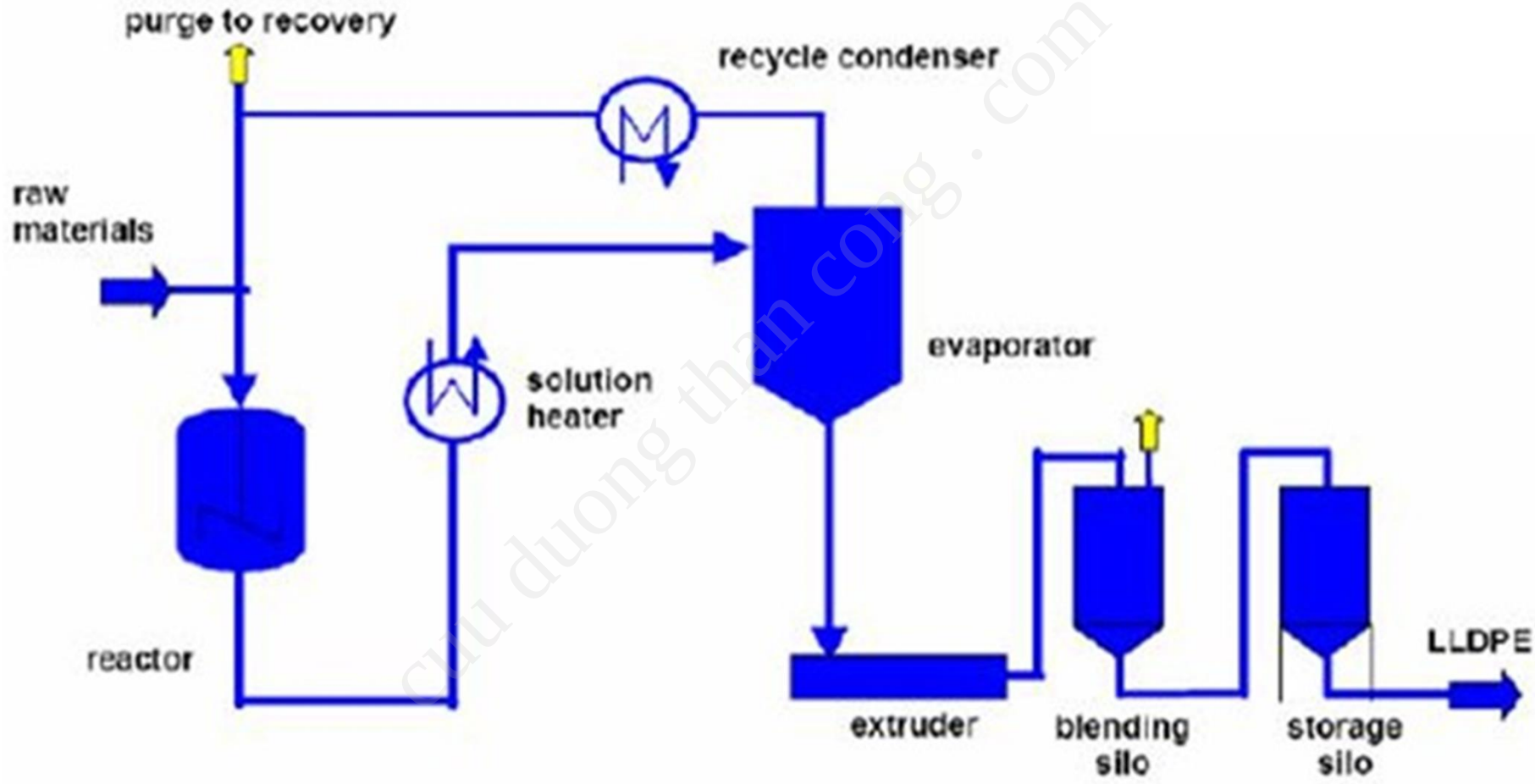
Kỹ thuật tổng hợp polyme

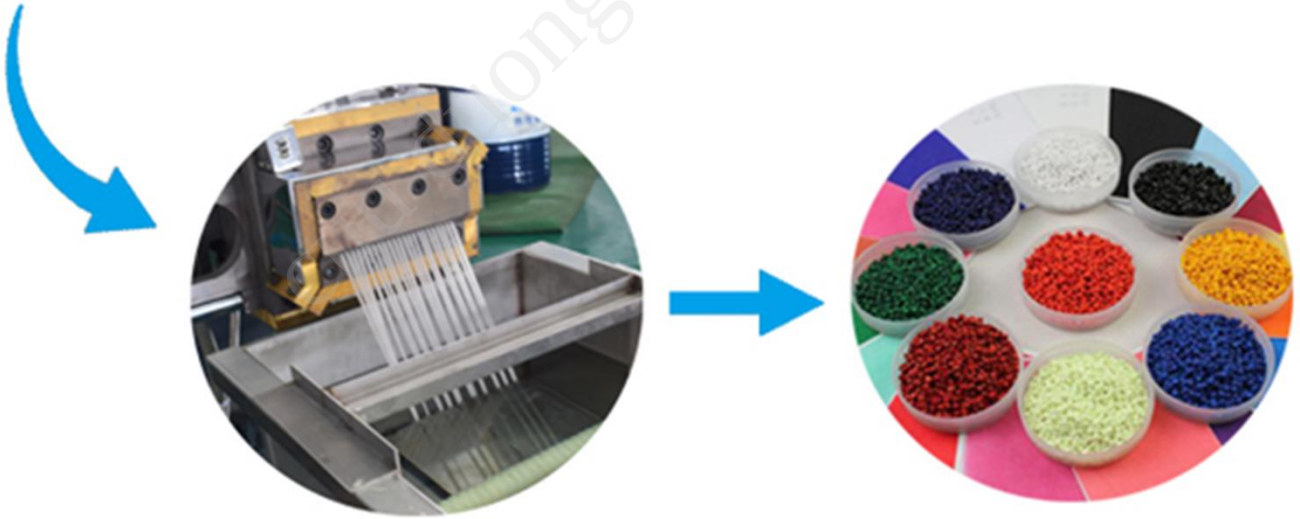
Phương pháp tổng hợp polyme:

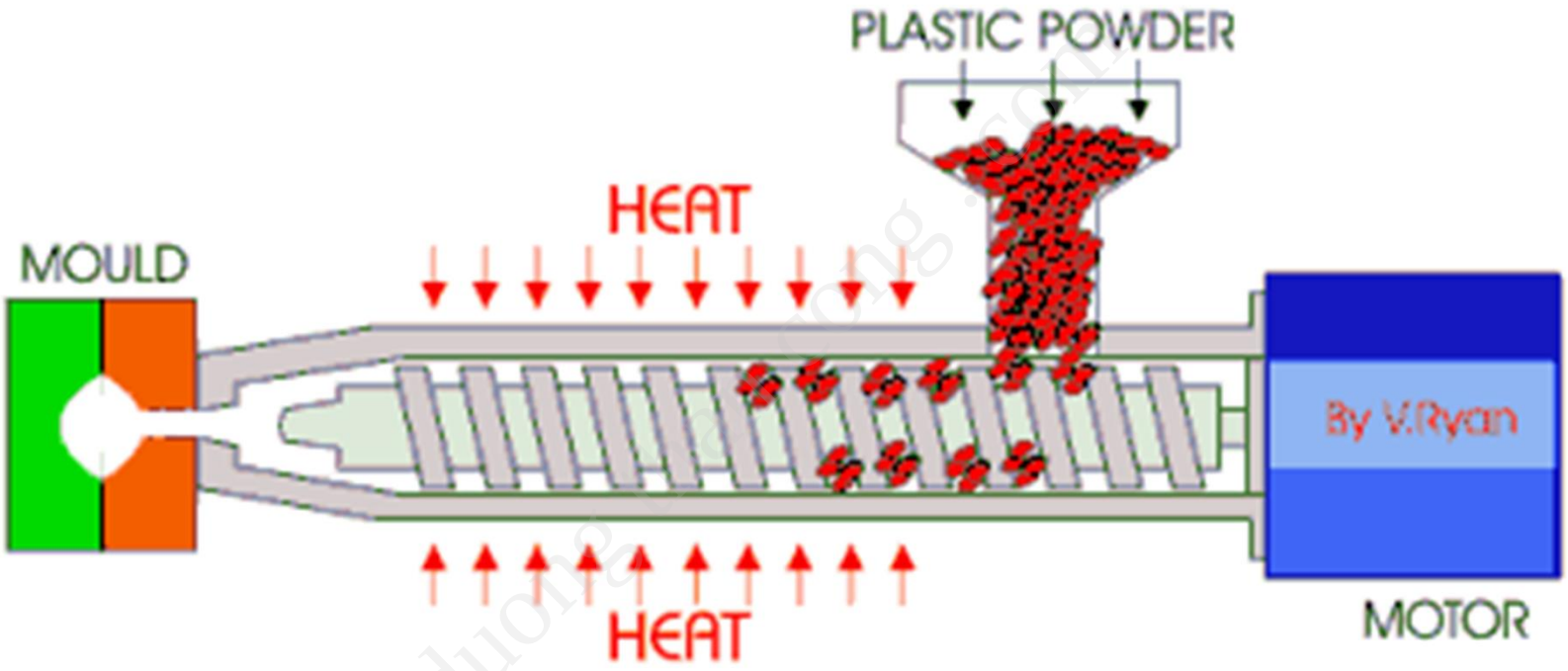
1. Trùng hợp dây chuyền
2. Trùng hợp bậc (trùng ngưng)
3. Biến tính

CHƯƠNG II
KỸ THUẬT TỔNG HỢP POLYME

Quy trình tổng hợp polyme







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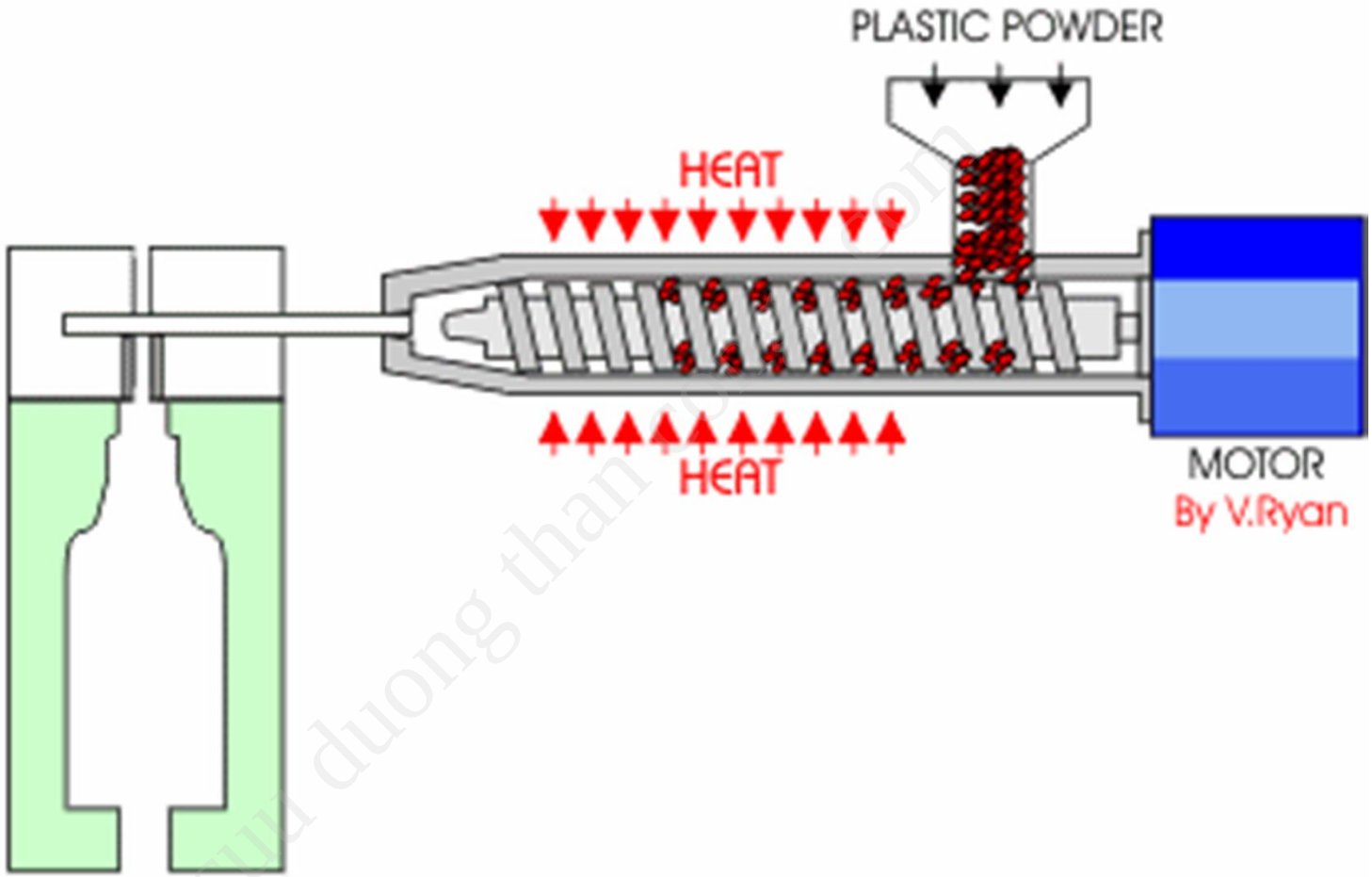


Các kỹ thuật trùng hợp (Polymerization Techniques)

Các công đoạn:

- Nạp nguyên liệu và hóa chất cần thiết
- Gia nhiệt đến nhiệt độ phản ứng
- Tiến hành tổng hợp
- Loại bỏ các monomer chưa phản ứng, dung môi…
- Làm nguội sản phẩm

Polymerization Techniques

1. Bulk polymerization
2. Solution polymerization
3. Suspension polymerization
4. Emulsion polymerization
5. Interfacial condensation polymerization

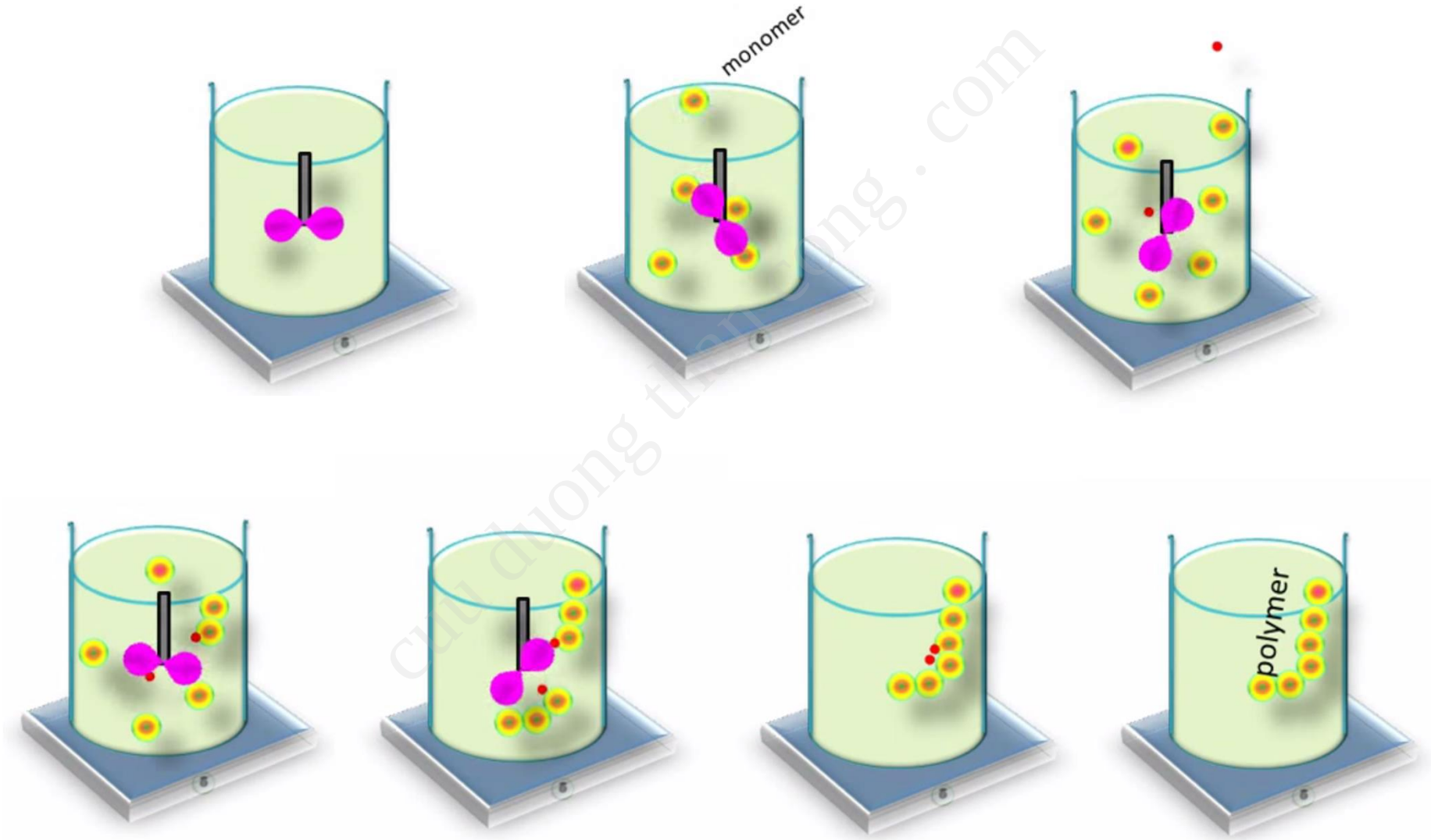
1.Bulk polymerization (Polyme hóa khối)

Homogeneous : polymer remains dissolved in monomers.

Ex. PMMA

Heterogeneous : Precipitation polymerization
polymer is insoluble in its monomers.
Ex. Polyacrylonitrile, PVC

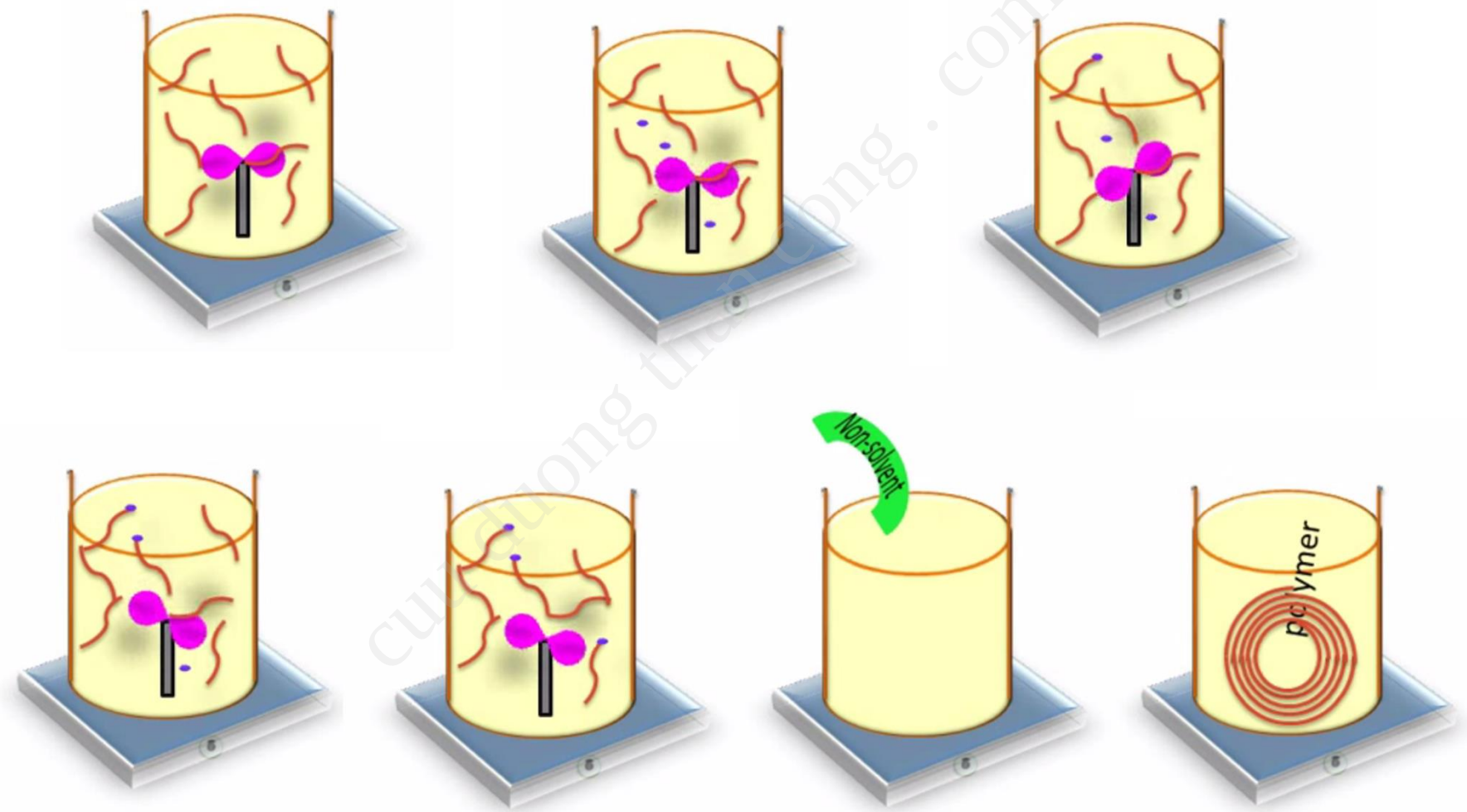
1.Bulk polymerization



2.Solution polymerization (polyme hóa trong dung dịch)

Monome
Chất khơi mào tan
Dung môi
(Chất ổn định vô cơ)

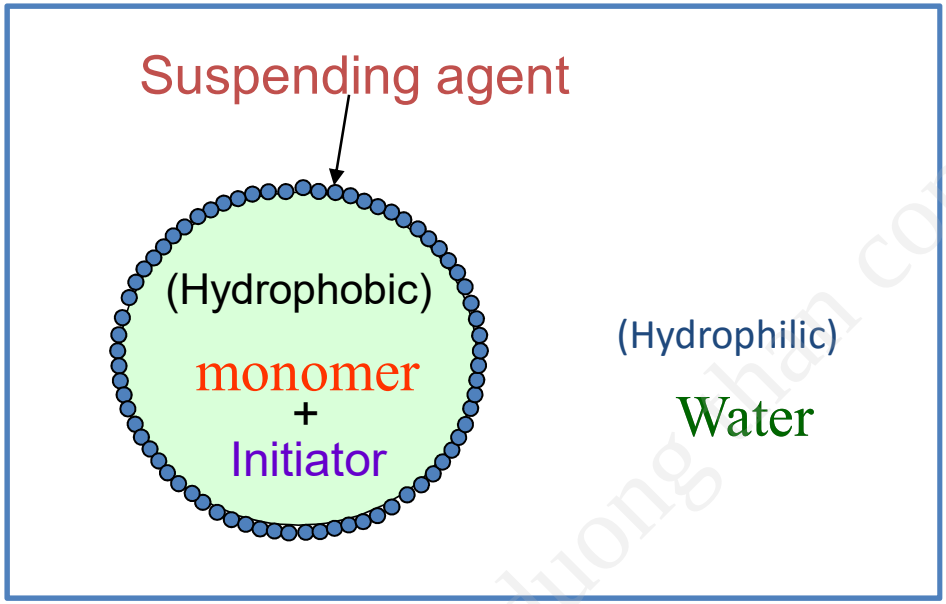
2.Solution polymerization

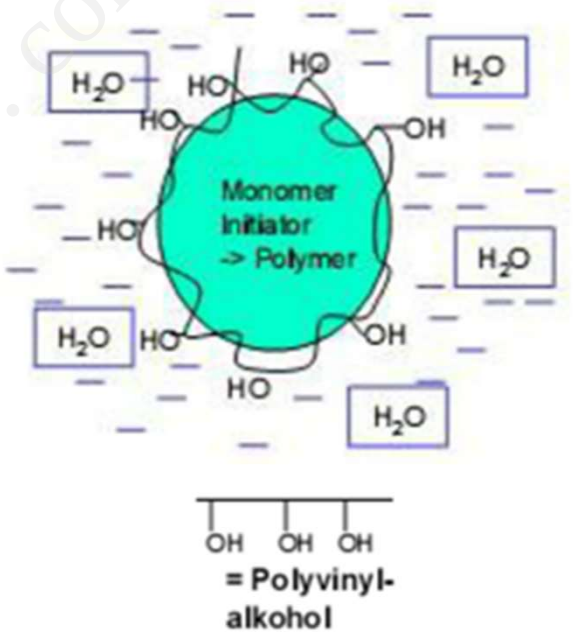


Polyme hóa trong pha phân tán:

- Polyme hóa huyền phù
- Polyme hóa nhũ tương

3.Suspension polymerization (polyme hóa trong huyền phù)





Monomer: styrene, MMA, VC, VA

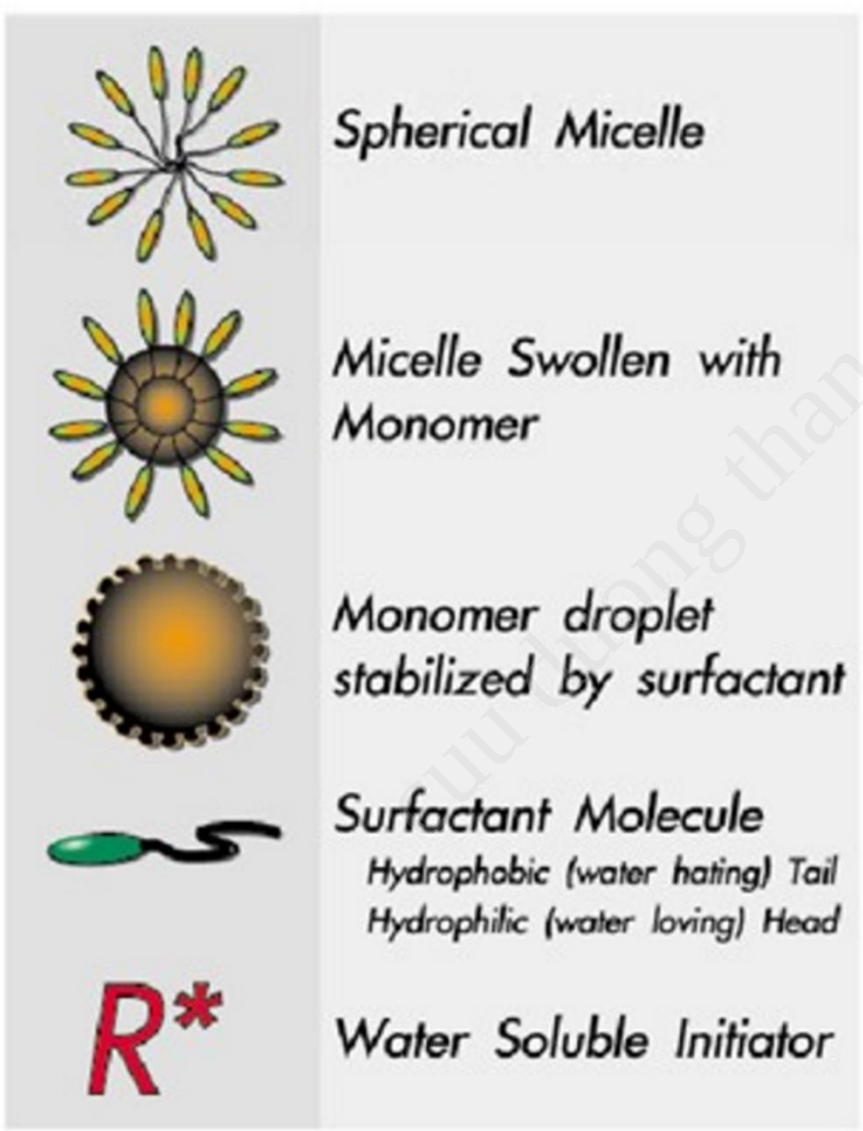
Chất ổn định: polymer ưa nước (PVA, polyvinylpyrolidone, tinh bột…), các muối vô cơ (bột talc…)

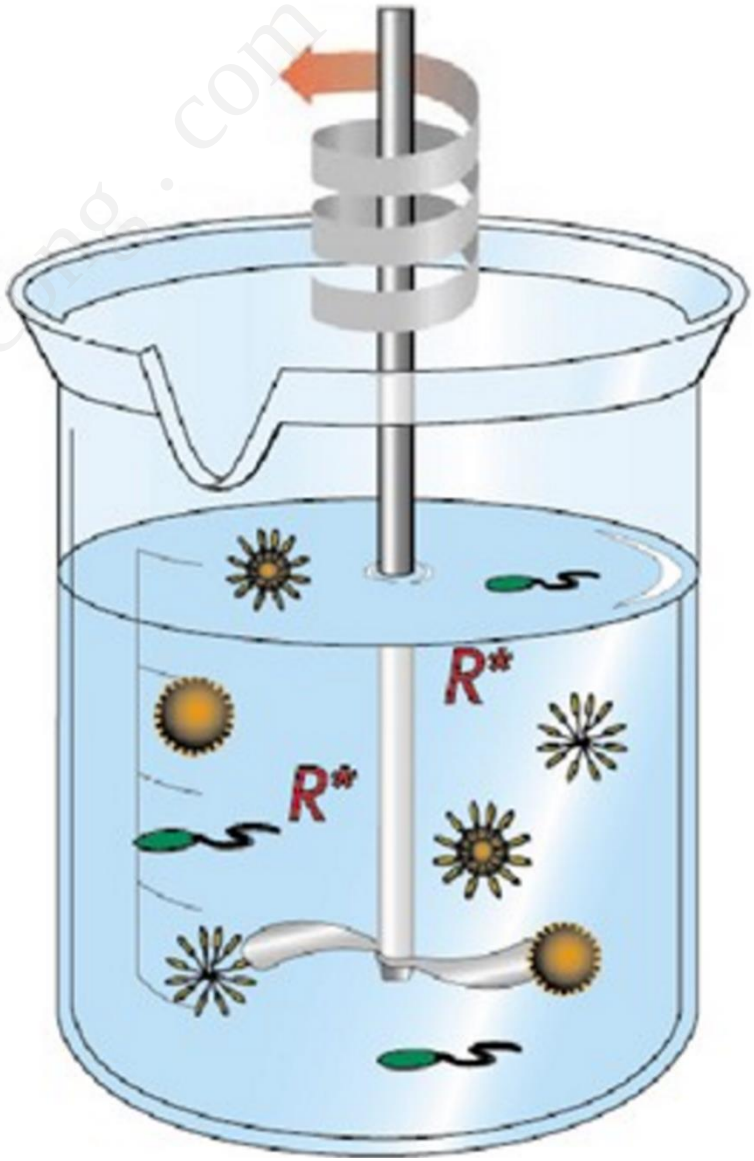
Chất khơi mào tan trong monomer: azo, diazo, peroxide…

Poly(vinyl chloride)

Vinyl chloride	100 parts
Water	180 parts
Poly(vinyl alcohol) *(suspending agent)*	0.04 parts
Trichloroethylene *(transfer agent)*	0.2 parts
Lauroyl peroxide *(initiator)*	0.2 parts

4.Emulsion polymerization (polyme hóa trong nhũ tương)





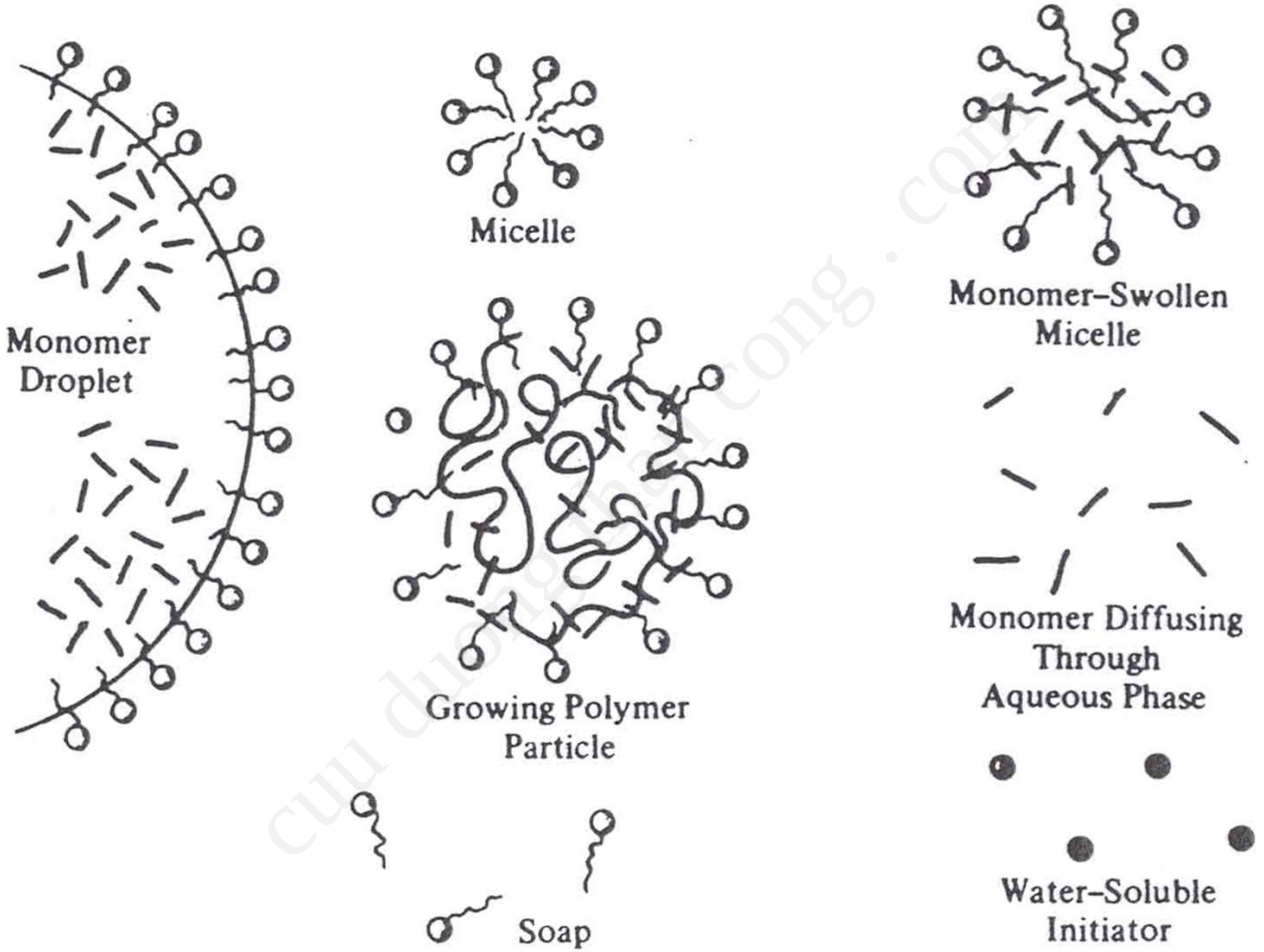
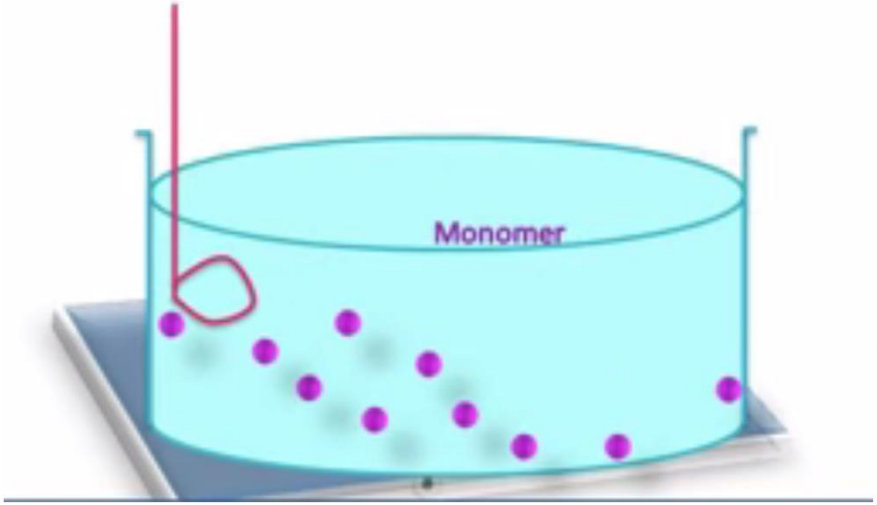


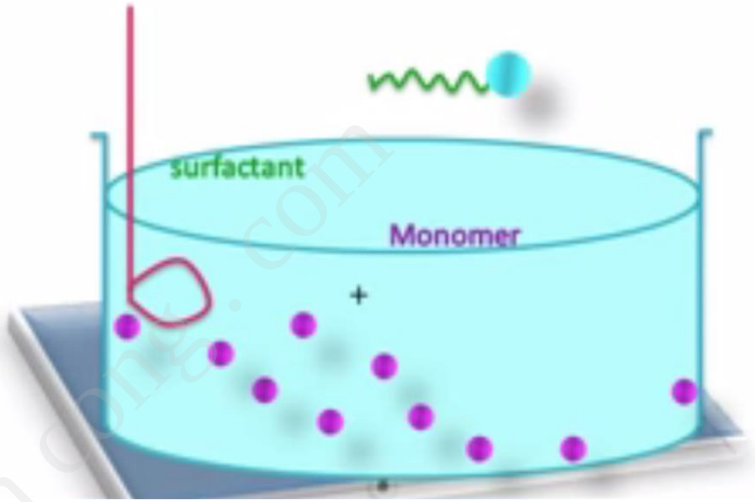
Figure 10.7 Structures in emulsion polymerization.

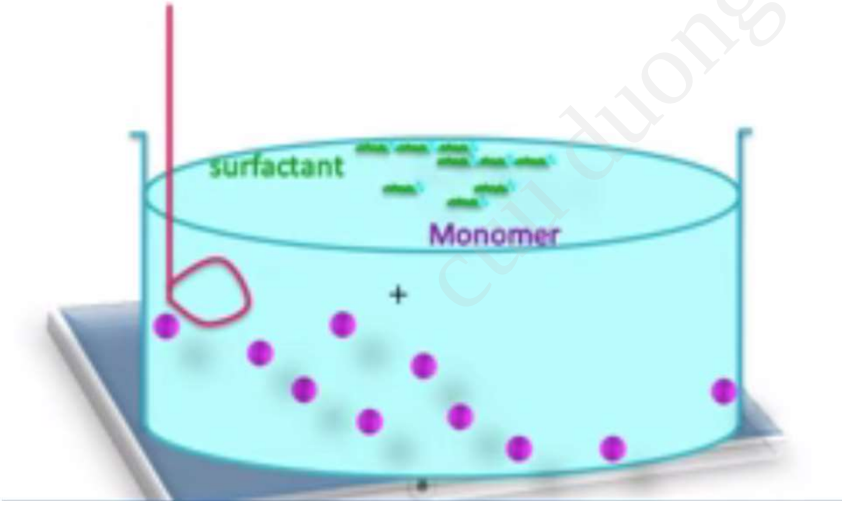
Ref: S.L. Rosen, John Wiley & Sons 1993

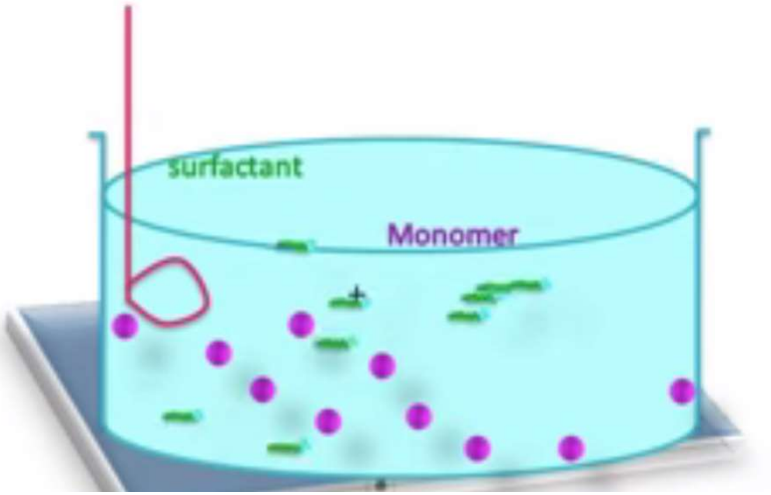
Preparation of Poly(vinyl chloride)

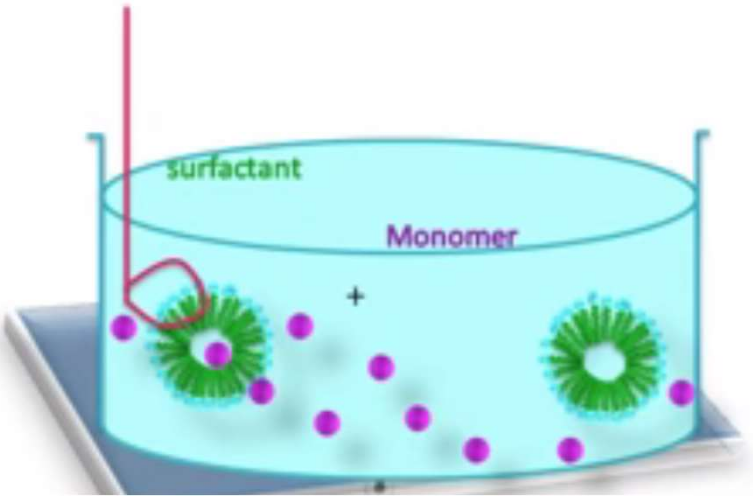
Vinyl chloride	100 parts
Water	200 parts
Ammonium stearate *(surfactant)*	3 parts
Potassium persulfate *(initiator)*	0.5 parts

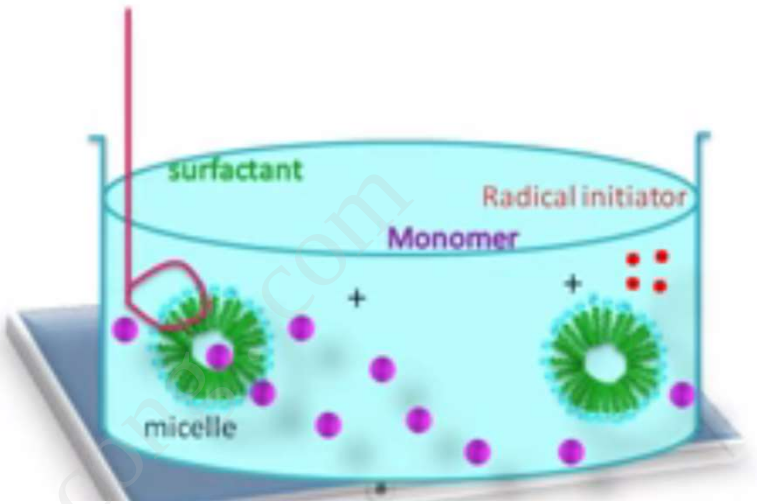


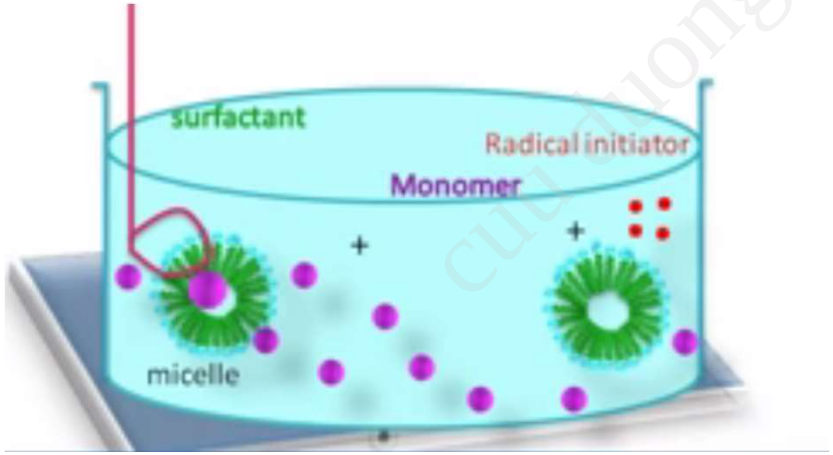


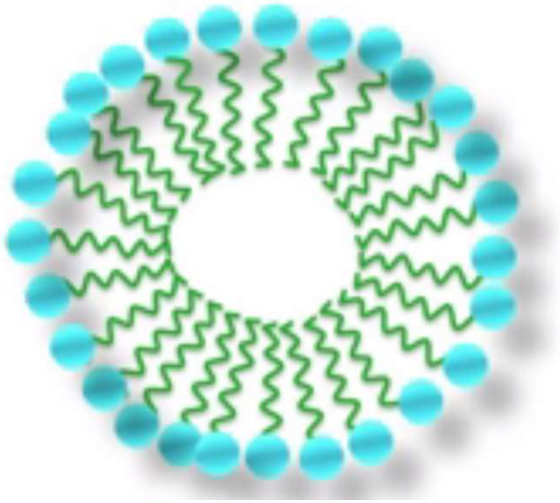


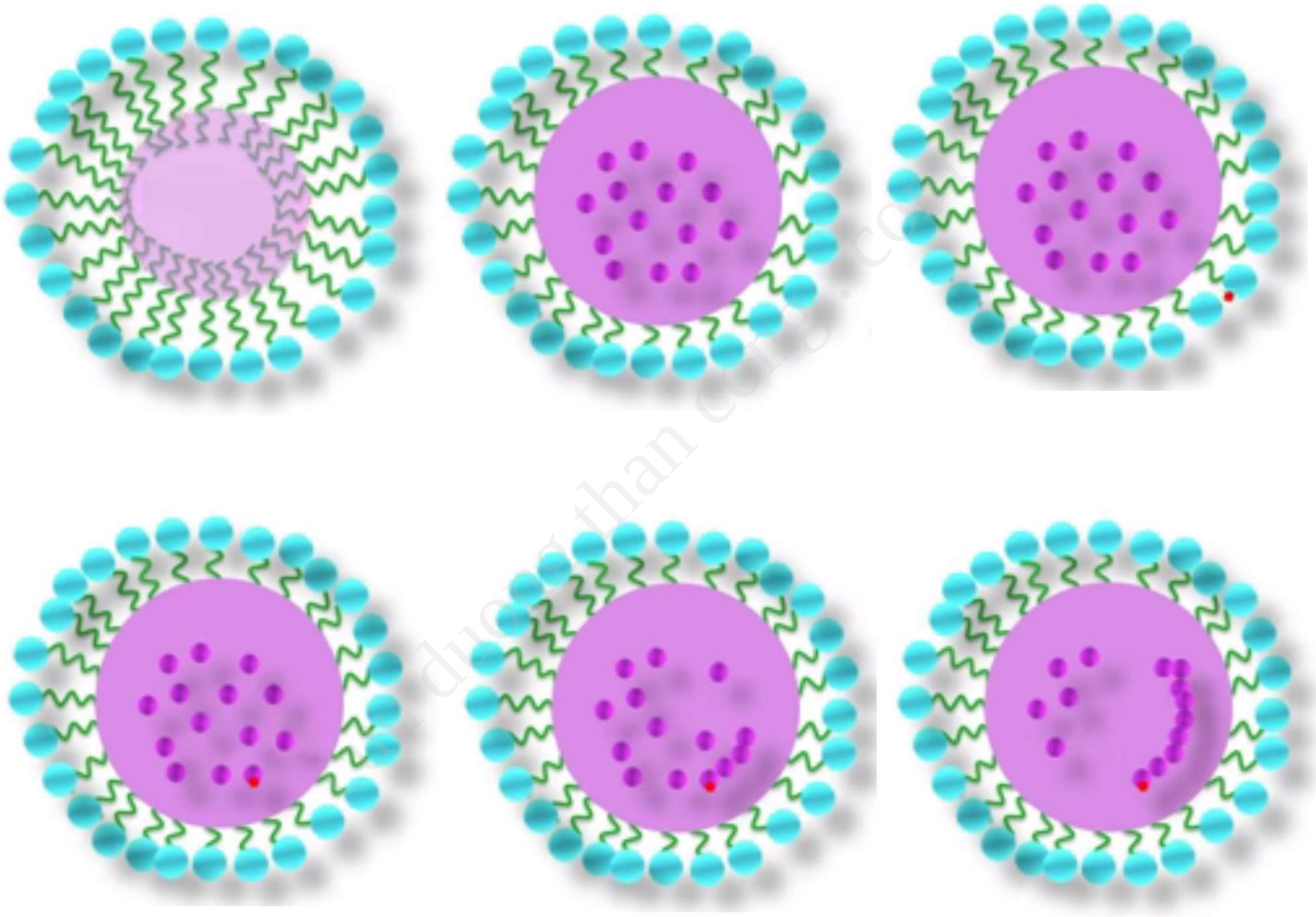


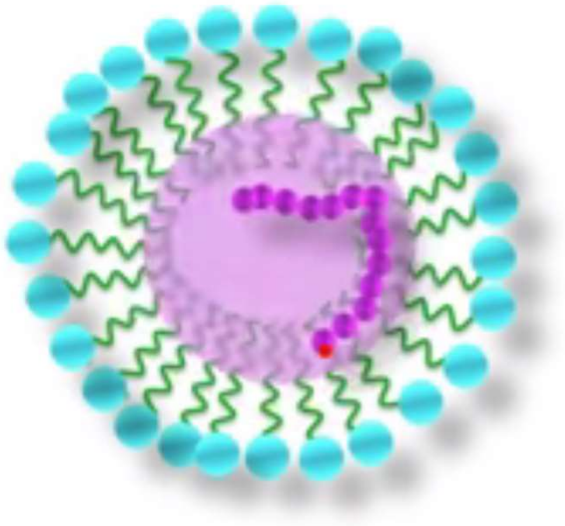


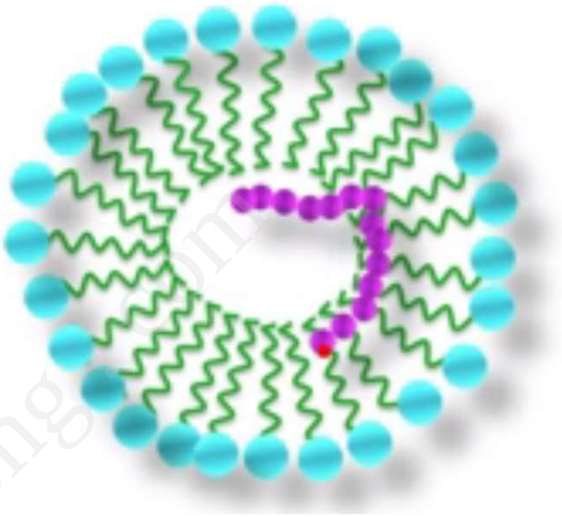


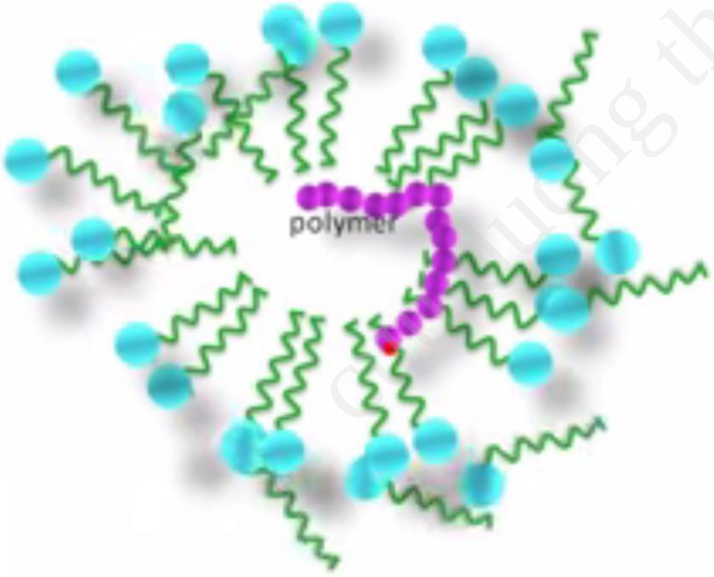


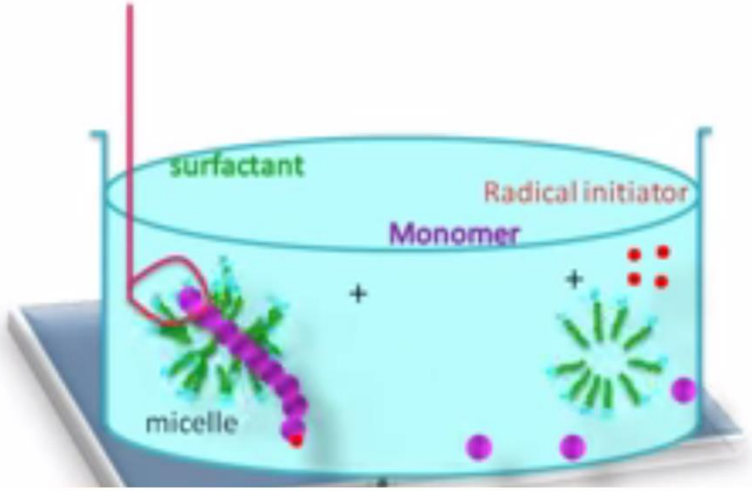


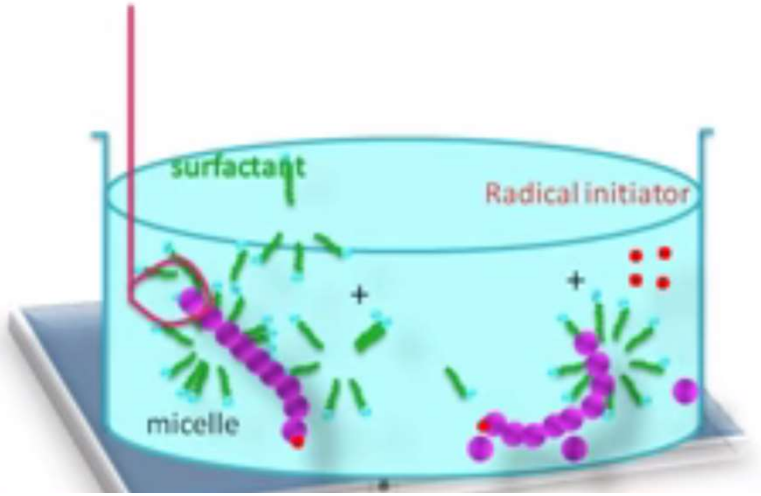


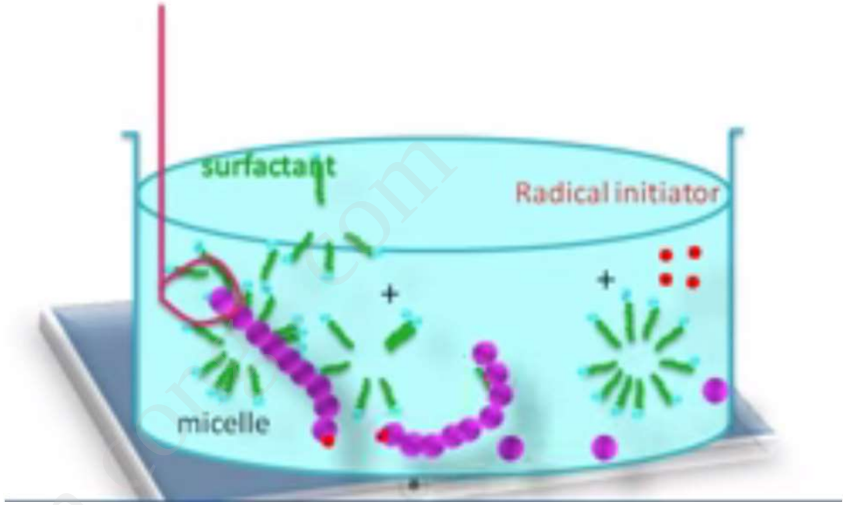


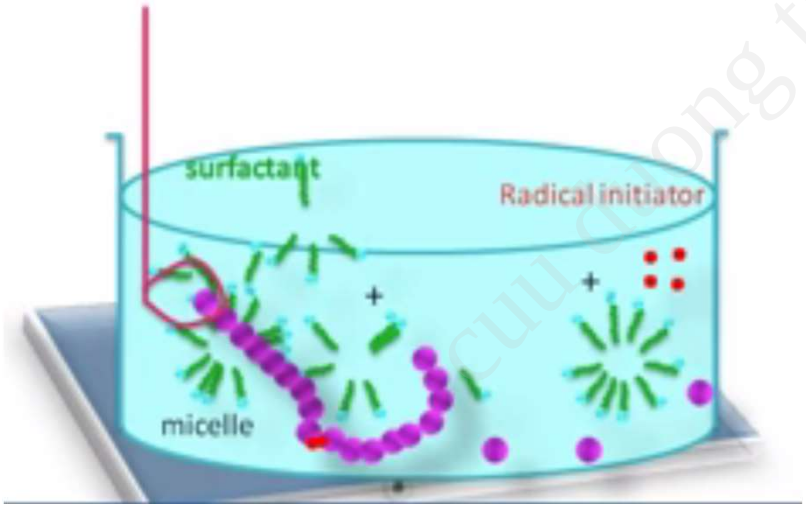












Monomer + H_2O + surfactant + Initiator

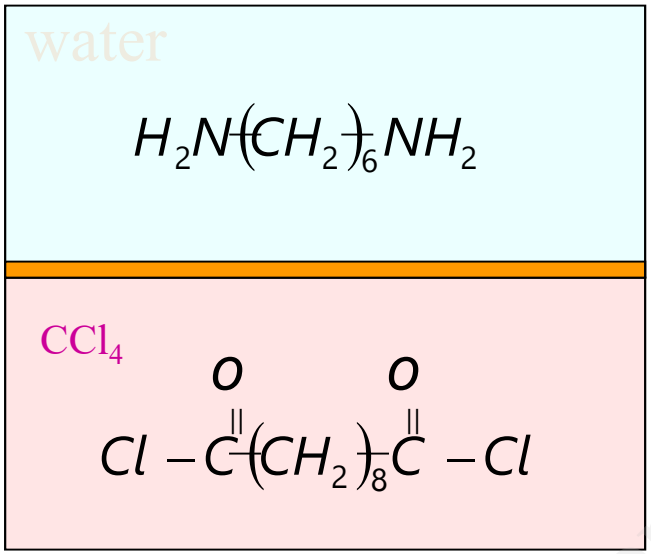
Heterogeneous medium

↓ Nitrogen atmosphere

Polymer

5. Interfacial Polycondensation

Interfacial Polycondensation of Nylon 6/11



Monomer1 : Hexamethlyene diamine $H_2N(CH_2)_6NH_2$

Polymer formed at interface

Monomer2 : Sebacoyl chloride $Cl-C(=O)(CH_2)_8C(=O)-Cl$

$$H_2N(CH_2)_6NH_2 + Cl-C(=O)(CH_2)_8C(=O)-Cl \rightarrow \left[N(H)(CH_2)_6N(H)-C(=O)(CH_2)_8C(=O)\right] + HCl$$

Commercial scale → easier to stir the phases together

Advantage : - Reaction → rapid at room temperature
(no need for high T., vacuum P.)